

In the matter of FCC-04-186

Comments of:

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I am Steven K. (Steve) Stroh and I am providing these comments to the FCC on the matter of Television Broadcast Spectrum "White Spaces" - FCC-04-186. The informal comments that follow are my personal views as a US Citizen and a person with some experience in the use of wireless technologies to provide Broadband Internet Access.

Disclosure:

I am a (lapsed) member of the Wireless Internet Service Providers Association (WISPA) and perhaps (uncertain of my status) a member of Part-15.org, both of which have filed comments with the FCC in this matter. While I am a member of the former's standing FCC Committee, I have not actively participated in, nor actively followed that committee's deliberations nor participated in the formulation of their position or comments to the FCC. I do not necessarily support, nor dismiss either organization's comments or views.

Background:

Although I received formal training in electronics, my primary technological background relevant to the subject of license-exempt use of "White Spaces" is considerable hands-on experience in wireless data communications using Packet Radio as a licensed Amateur Radio Operator "N8GNJ. As a Ham, one learns a LOT about how radio communications REALLY works" the theory, the practice, the technology. My primary professional background is as a Systems and Network Administrator, and later, as a writer on various technology subjects, primarily Broadband Wireless Internet Access.

As an Amateur Radio Operator, I participated peripherally in a Special Temporary Authority (STA) operated by various Amateur Radio organizations to experiment with the use of Spread Spectrum technologies in Amateur Radio. That experience piqued my curiosity about the use of wireless data communications, which led me to self-educate (via the early commercial Internet) on the topic of what I came to call Broadband Wireless Internet Access, later standardized into technologies and "brands" such as WiMAX and Wi-Fi. At a point where I had learned a lot about the subject, I proposed a column on the use of wireless technologies in providing Internet Access to Boardwatch

Magazine. I began writing my “Wireless Data Developments” column in April, 1997. That column ran for almost five years, and led to a number of other writing opportunities, speaking engagements at conferences, consulting work, and participation as a commenter and appearance on a panel of the FCC’s Spectrum Policy Task Force. I started, and continue to write one of the earliest blogs on the subject of Broadband Wireless Internet Access (now titled Broadband Wireless Internet Access / WiMAX News) at [www.bwianews.com](http://www.bwianews.com).

One of my last opportunities to write for Boardwatch was a little-noticed article, in that little-noticed publication, in January, 2002, was an article titled “Wireless Smart Radio, Heavy Lobbying Would Bring Wireless ISP Band.” In that article, preserved online via the Internet Archives at <http://web.archive.org/web/20021212225707/http://www.ispworld.com/boardwatchonline/2002/jan02/technology-wireless.htm>

In that article, I proposed the essential elements of what has now come to be known as “White Spaces”. The primary points I made were:

- \* There was, and would continue to be, ample unused portions of spectrum in the portions of bands allocated to television broadcasting;
- \* Some simple rules, such as detecting actual television broadcast transmissions, would reasonably insure that there would be a minimum, if any actual interference\*;
- \* License-exempt use would be entirely feasible if those rules were embedded into the radios;
- \* That the most useful purpose for “White Spaces” would be by those providing Broadband Internet Access;
- \* That the primary obstacle to implementing “White Spaces” would be political objections, not technological obstacles.

I am comfortable in saying that I have been seriously considering “White Spaces” ever since, and considerably longer than most, and I have given considerable thought to the various approaches that have been outlined for implementing “White Spaces”.

Thus, I commend the Commission for their research and apparent willingness to seriously consider the possibility, and more importantly, the potential of “White Spaces” in the face of the (totally predictable) political opposition from the broadcasters and their cronies. I honestly didn’t think that 04-186 would actually be acted upon by the FCC “at least in this decade.

My primary conclusion from more than six years of “mulling over” the possibility of “White Spaces” is that “spectrum sensing” should be the primary method of insuring non-interference with television broadcasting. Television transmitters are very powerful, even “low power” stations, and their transmission systems are always very well-engineered to insure uniform coverage over their intended service area. Therefore, it’s reasonable to posit that a “White Spaces”

device could reasonably be expected to “hear” a television transmitter’s signal “well enough to “know” that a particular television channel is in use for television broadcasting and “the rule” embedded into the radio would be, of course, “if you hear a television signal, even if it’s weak, don’t use that channel”.

That there were some issues in the “spectrum sensing” capabilities of the prototype “White Spaces” devices that the Commission’s technical personnel recently tested is, in my opinion, merely an artifact of very early technology. The first Wireless LAN / Broadband Wireless Internet Access devices weren’t exactly a rousing technological success either. What was being tested in those prototype “White Spaces” devices was the concept “COULD license-exempt “White Spaces” devices be made to work “ was the CONCEPT valid? From my reading of the FCC’s most recent report on the testing of prototype license-exempt “White Spaces” devices, the answer is Yes “ the concept IS valid and could be made to work with good-enough technology. And thus the next step for the Commission is create rules that allow the “White Spaces” concept to be realized. Creating the “good-enough” technology is for industry to create in the wake of Commission rules for “White Spaces” operations “ exactly like what happened for the first wireless broadband devices in the wake of the commission’s revision Part 15.247 in 1985.

My particular experience and judgment combine to conclude that “spectrum sensing” combined with “beacons”, is a good compromise solution to the issue of wireless microphones, which, essentially, “squats” on vacant television channels, as well as other non-television use of television broadcast spectrum. A “beacon” could transmit at higher power levels than wireless microphones, using a robust modulation technique (so the beacon’s transmitted power level wouldn’t need to be anywhere near that of a television broadcast transmitter). The information transmitted in the beacon could “explain” to “White Spaces” devices which television channels should not be used in a particular area. Like wireless microphones are supposed to be (but rarely are!) such beacons should be licensed / registered with the FCC to curb the potential for abuse by broadcasters and competing providers of Broadband Internet Access.

The use of “spectrum sensing” will allow “White Spaces” technology, systems, and devices to evolve much more rapidly than they would otherwise be able to if “geolocation database” was mandated for each white space devices. It seems unlikely that Wi-Fi, Wireless ISPs, or cordless phones could ever have come into being if each device and system was burdened with the requirement of a full-time Internet connection, a GPS receiver, or an embedded database of “all the places you’re not allowed to transmit” (or, alternatively, the few places the device WAS allowed to transmit! at the time of manufacture).

Much of my writing about Broadband Wireless Internet Access over the past decade has focused on

the small Wireless Internet Service Providers (WISPs) such as those represented by WISPA and Part-15.org. While there are small WISPs serving metropolitan areas, WISPs are much more prominent and vital in non-urban and rural areas. WISPs often provide the only alternative to expensive and (generally) poor-performing satellite-based Broadband Internet Access. For WISPs, and indeed, any entity (including individuals) with a mission to provide Broadband Internet Access, such as Indian Nations, remote villages, even ships and oil platforms offshore, license-exempt use of "White Spaces" would prove to be far more effective in providing Broadband Internet Access than current spectrum and technologies.

In my consulting, I've been asked to help out on various proposals to implement Broadband Wireless Internet Access and one constant in many of my consultations has been that the lack of suitable spectrum has stymied many worthy attempts at providing Broadband Wireless Internet Access to areas where Broadband Internet Access is otherwise unavailable or unaffordable. One example that I was peripherally involved in was that Wal-Mart was at one time interested in setting up "cell sites" at each of their stores to provide reasonably-priced Broadband Internet Access via wireless to the communities surrounding each store. Wal-Mart had enough scale and financial resources to provide the needed high-speed "backbone" links (already in use at each store) and to construct the towers and radio systems. What ultimately stymied these proposals was that the license-exempt spectrum that was available at the time could not provide sufficient "penetration", scale, and quality of service to make a compelling business case. "White Spaces" would make such a system entirely feasible. (I have no affiliation whatsoever with Wal-Mart.)

#### Conclusion:

I commend the Commission for its continual adaptation of the original Part 15.274 rules and regulations for license-exempt devices and systems, and their courageous stand not to "pick winners" in the numerous "turf battles" that inevitably arose from the competing and at times incompatible uses of ISM and UNII bands. That approach led me to posit a theory I call "The Darwinian Effect Of License-exempt Wireless". Briefly, that is that license-exempt communications devices that are "competing" in a "competitive ecosystem" such as the ISM and UNII bands must continue to evolve to perform better, cost less, and be "robust" because not only of the environment but also because of the intense competition of many vendors and different technological approaches.

Initially, the Part 15.247 rules were extremely confining. But technology "incredible advances in cost-effective digital signal processing, computing "horsepower" and memory capacity, algorithms, as well as incredible advances in semiconductor manufacturing, materials research, and resurrection of formerly-impractical technologies such as MIMO and OFDM, overcame those otherwise-crippling limitations. Competition and demand did the rest. I watched (and discussed,

at length, with a number of FCC personnel) how the Commission come to understand that  
“loosening” the Part 15.247 rules would result in even higher usage and economic activity. They  
did! and it did.

I believe that the result will be similar with LICENSE-EXEMPT use of “White Spaces” if the  
Commission has the courage to implement minimal rules that are biased towards the future, such as  
requiring (perhaps quite strict, and thus a “technological stretch” at first) “spectrum  
sensing” approach, instead of an “only-lawyers-could-love-it” “geolocation database”  
requirement. The United States invented the Internet. With White Spaces, the US could re-invent the  
Wireless Internet.

\* Paul Baran formulated prescient “Kindergarten Rules” for license-exempt wireless devices -  
[www.winlab.rutgers.edu/~crose/baran.html](http://www.winlab.rutgers.edu/~crose/baran.html).